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Electrical resistivity tomography at the search of groundwater near Anapa town in the south of Russia.

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Electrical resistivity tomography at the search of groundwater near Anapa town in the south of Russia.
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Due to acute shortage of fresh drinking water near Anapa town (not far from the Black Sea), geophysical investigations were performed for searching and mapping aquifers in the area, where, according to rare wells exist probability to find fresh underground water.
Geophysical explorations were carried out by Electrical resistivity tomography (ERT) method and water resistivity measurements. The resistivity of fresh groundwater is 15 Ohm.m, its salinity is 0.4 g/l.
The structure of the area has been obtained by previous geological and hydrogeological studies and boreholes drilling.
Geological structure of the area consists of two parts: the upper part of cross-section presented by loose lacustrine-alluvial sediments of Upper Pleistocene - Holocene, the lower part presented by hard rocs of carbonate-flysch formation of Upper Cretaceous age consisted of marl and limestone.
Prospective areas to find underground water are: water-bearing horizon of upper Pleistocene-Holocene sediments, which is presented by gravel layer (base layer of modern lacustrine-alluvial sediments), and fractured zones in hard rocks of the carbonate-flysch formation of Maastricht age (Supseh formation).
Analysis of rocks' resistivity obtained from Electrical resistivity tomography followed by calculation of rock resistivity on known petrophysical parameters (in Petrowin program created by A. A. Ryjov) [Shevnin et al., 2007]. The calculation showed that there is low clay content in carbonate rocks of the studied area, and the rock is limestone, not marl.
Measurement of rock samples with X-ray radiometric method showed high calcium content (30-35%) or 75-87.5% limestone. This fact shows that flysch formation of the area is mainly carbonate, which is fit to results of petrophysical modeling with Petrowin program, which calculated rock resistivity from porosity and clay content.
On the base of Electrical resistivity tomography results, calculated rocks' resistivity and drilling data, table of rocks' resistivity was created and resistivity intervals promising to search for underground water were determined.
Electric resistivity of rocks in cross-section according to histogram obtained on Electrical resistivity tomography data varies from 20 to 600 Ohm.m and clear divides into two sections: 20-100 Ohm.m for loose sediments and 70-600 Ohm.m for hard rocks.
On geoelectrical resistivity sections, which were obtained from Electrical resistivity tomography inversion, we draw isolines of boundary values for resistivity (50-100 Ohm.m for sandy-gravel layer, 100-150 Ohm.m for fractured carbonate-flysch), which detached promising areas to search for underground water taking with account aquifers position according to wells.
As a result the Electrical resistivity tomography method succeeded to search groundwater and to determine aquifers position. We pointed out several areas for subsequent drilling found with Electrical resistivity tomography, and we are waiting confirmation of underground water findings.
Reference
Shevnin V., Mousatov A., Ryjov A. and Delgado-Rodriquez O. Estimation of clay content in soil based on resistivity modeling and laboratory measurements. Geophysical Prospecting, 2007, 55, p.265-275